Supervised Descent Method

Abstract

In this dissertation, we focus on solving NLS problems using a supervised approach. In particular, we developed a Supervised Descent Method (SDM), performed thorough theoretical analysis, and demonstrated its effectiveness on optimizing analytic functions, and four other real-world applications: Inverse Kinematics, Rigid Tracking, Face Alignment (frontal and multi-view), and 3D Object Pose Estimation.

In Rigid Tracking, SDM was able to take advantage of more robust features, such as, HoG and SIFT. Those non-differentiable image features were out of consideration of previous work because they relied on gradient-based methods for optimization. In Inverse Kinematics where we minimize a non-convex function, SDM achieved significantly better convergence than gradient-based approaches. In Face Alignment, SDM achieved state-of-the-arts results. Moreover, it was extremely computationally efficient, which makes it applicable for many mobile applications. In addition, we provided a unified view of several popular methods including SDM on sequential prediction, and reformulated them as a sequence of function compositions. Finally, we suggested some future research directions on SDM and sequential prediction.